Iteration #2 Results

Water Temperature Modeling

HEC-RAS/WQ

SRT Meeting – February 28, 2013
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Outline

- Evaluation criteria
- Overview of the modeling/analysis
- Model/analysis results
- Summary

Evaluation Criteria

- HEC-RAS/WQ model was used to assess potential effects of alternatives on water temperatures
- Water temperatures evaluated at four primary locations
  - Columbia River
    - downstream of Priest Rapids (Hanford Reach, rivermile 342)
    - downstream of Bonneville
  - Snake River
    - downstream of Ice Harbor
    - Clearwater at Spalding, ID

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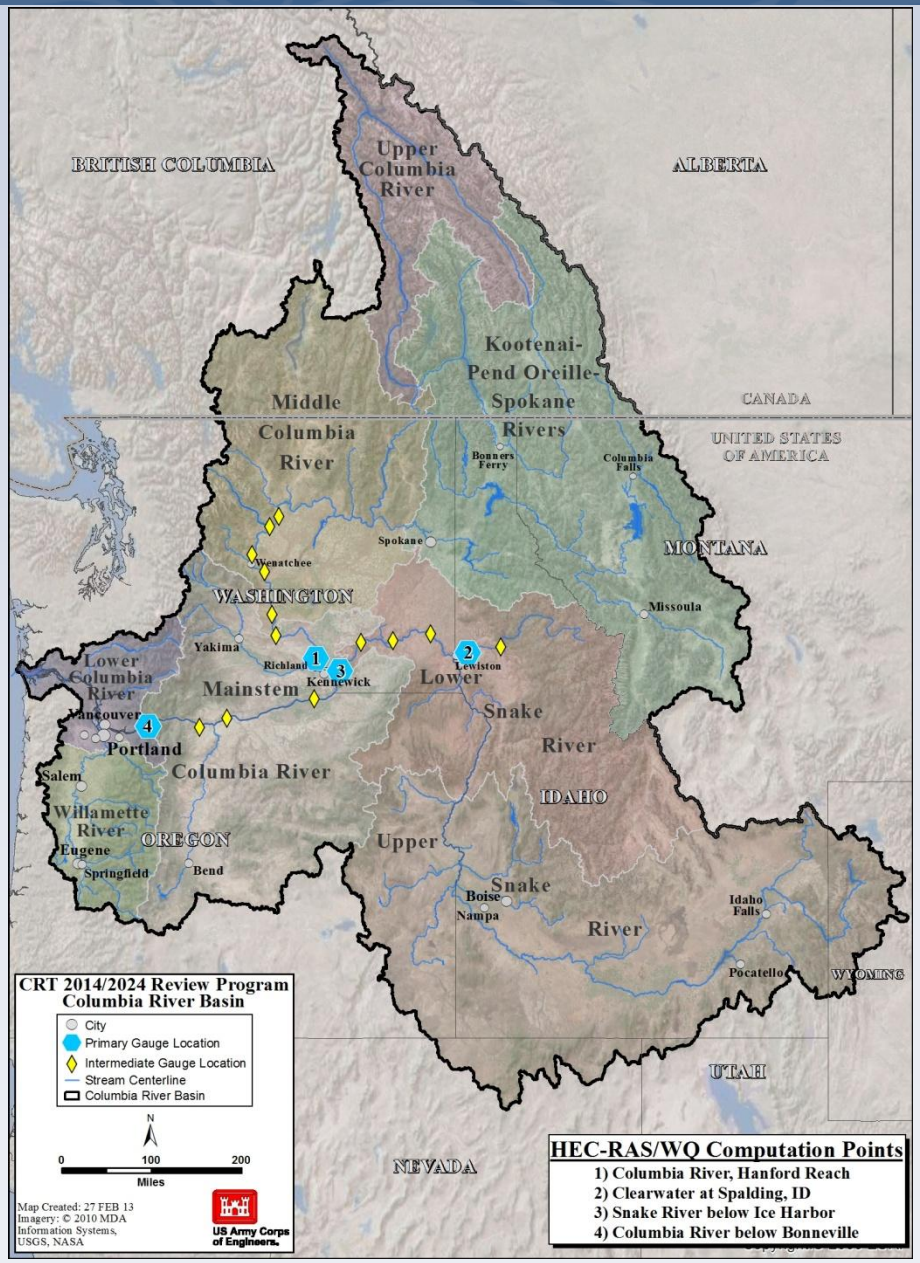

Modeling Methods

- Modeling approach
  - Calibrate HEC-RAS/WQ model parameters to known water temperature data (Note: HEC-RAS hydraulic components were built and calibrated through CRT 2014 Flood Risk Analysis)
  - Apply HEC-RAS/WQ model for prediction
- Model Calibration
  - Water temperature data for 17 locations
  - Weather data for very hot (1998), hot (2009), and cold years (2011) applied, and observed flow for same year
  - Simulated water temperature results compared with measured values for 1998, 2009, and 2011
  - Error less than 1.2º C

Modeling Methods

- Key attributes of the model/analysis
  - 1- D thermal transport in downstream direction
  - Input total daily outflow from HYDSIM model, and data for upstream boundaries
  - Hydrologic data are for low, average, and high flow conditions by water year (WY) 1941, 1962, and 1997
    - Paired 1941 (low flow) with 1998 (hot weather)
    - Paired 1962 (medium flow) with 2011 (cold weather)
    - Paired 1997 (high flow) with 2008 (average weather)

Modeling Results

low flow, hot weather

Columbia - Hanford Reach (1941/1998)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	20.9	23.2	64
2A-TC	21.0	23.2	64
2A-TT*	21.5	24.0	68
2B-TC	20.9	23.2	64

Clearwater at Spalding (1941/1998)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	15.2	19.5	0
2A-TC	15.2	19.5	0
2A-TT	15.2	19.5	0
2B-TC	15.2	19.5	0

*2A-TT has lower summer flows on mainstem than other alternatives.

Modeling Results

low flow, hot weather

Snake below Ice Harbor (1941/1998)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	20.9	22.8	67
2A-TC	20.9	22.8	67
2A-TT	21.0	22.9	68
2B-TC	20.9	22.8	67

Columbia below Bonneville (1941/1998)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	22.4	24.5	84
2A-TC	22.4	24.6	83
2A-TT	22.6	25.0	84
2B-TC	22.4	24.7	85

Modeling Results

medium flow, cold weather

Columbia - Hanford Reach (1962/2011)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	18.9	21.4	32
2A-TC	19.1	21.4	33
2A-TT	19.3	21.5	40
2B-TC	19.1	21.6	39

Clearwater at Spalding (1962/2011)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	11.9	14.6	0
2A-TC	11.9	14.6	0
2A-TT	11.9	14.6	0
2B-TC	11.9	14.6	0

Modeling Results

medium flow, cold weather

Snake below Ice Harbor (1962/2011)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	17.2	20.2	7
2A-TC	17.2	20.2	6
2A-TT	17.2	20.2	7
2B-TC	17.2	20.2	7

Columbia below Bonneville (1962/2011)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	18.6	20.4	25
2A-TC	18.6	20.4	21
2A-TT	18.8	20.7	30
2B-TC	18.6	20.5	23

Modeling Results

high flow, average weather

Columbia - Hanford Reach (1997/2008)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	19.1	21.1	10
2A-TC	19.1	21.1	10
2A-TT	19.2	21.5	12
2B-TC	19.1	21.1	10

Clearwater at Spalding (1997/2008)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	13.5	15.5	0
2A-TC	13.5	15.5	0
2A-TT	13.5	15.5	0
2B-TC	13.5	15.5	0

Modeling Results

high flow, average weather

Snake below Ice Harbor (1997/2008)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	19.0	21.2	27
2A-TC	19.0	21.2	24
2A-TT	19.0	21.2	27
2B-TC	19.0	21.2	26

Columbia below Bonneville (1997/2008)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	20.3	22.2	48
2A-TC	20.2	21.9	47
2A-TT	20.3	22.0	50
2B-TC	20.3	21.9	47

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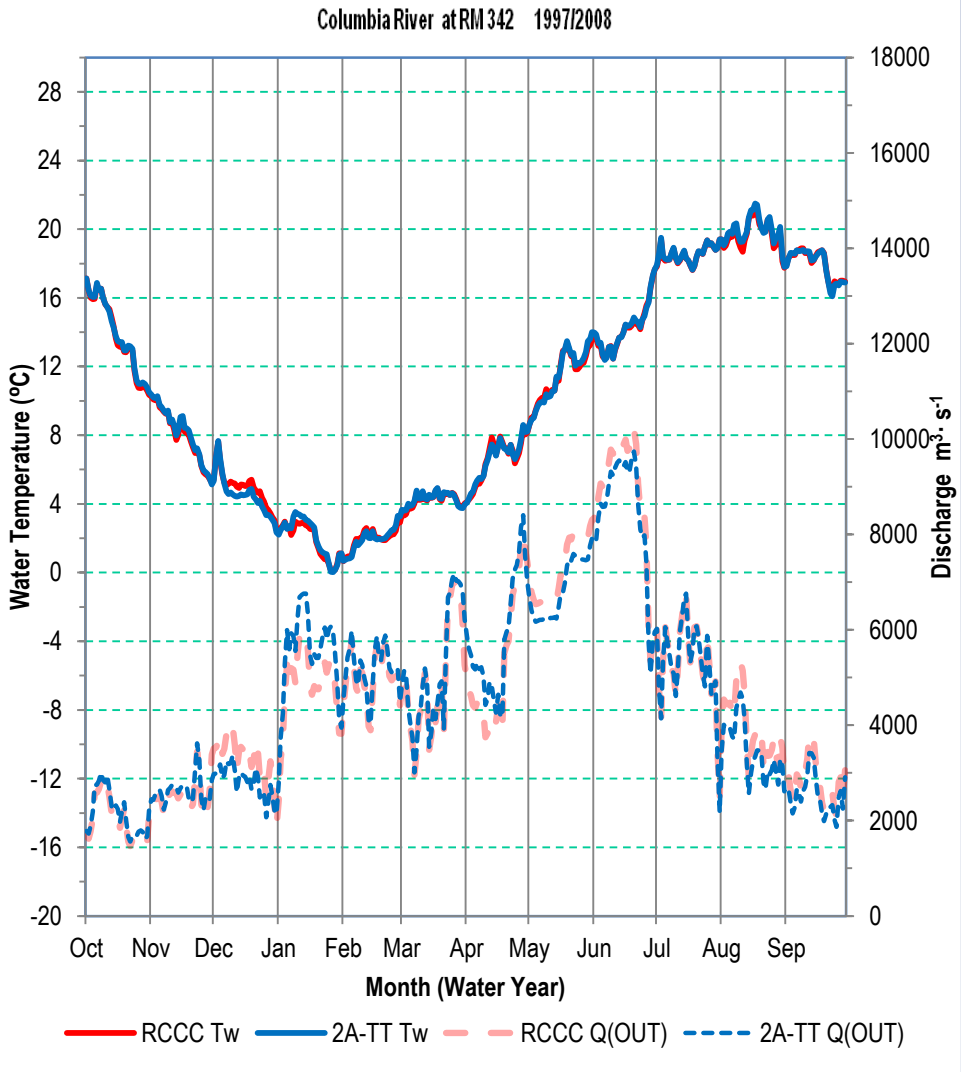
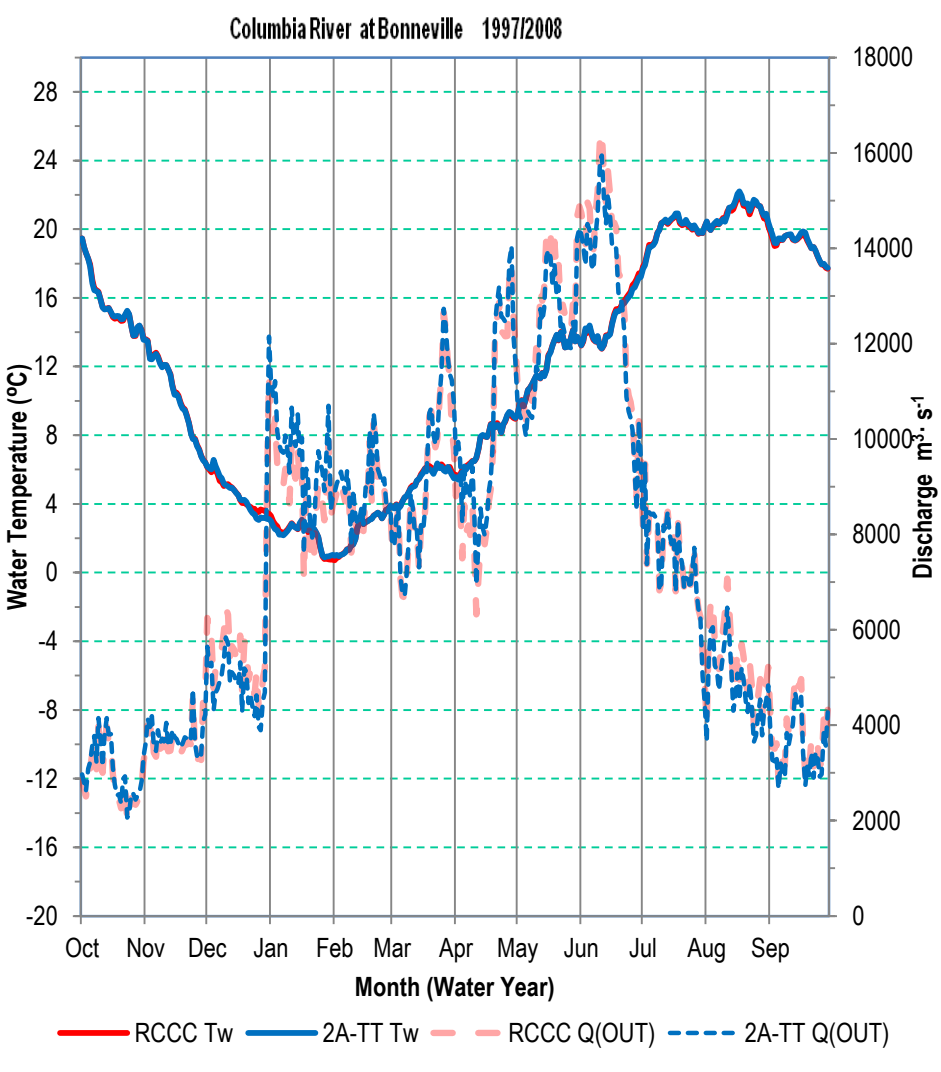
Model Results

high flow, average weather





Summary

- Results
  - Weather conditions are the primary driver of water temperatures
  - For the same meteorological drivers, there is minimal variation in water temperature (and duration of high temperatures) from RC-CC for the three alternatives 2A-TC, 2A-TT, and 2B-TC
  - Slight increase in the number of days above 20ºC for 2A-TT
  - The low flow/hot weather data pairing (1941/1998) caused maximum predicted water temperatures at primary sampling locations and for all alternatives